Viewpoint

Official cigarette tar tests are misleading: use a two-stage, compensating test

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The standard smoking-machine test for cigarettes[1] has a strong and regrettable power over cigarette sales and public health. The official test determines which cigarettes are called low-tar, light, or ultralight. Such a test establishes which cigarettes meet the European Union (EU) maximum of 12 mg tar, and will confirm compliance with a proposed change in maximum tar to 10 mg and 1·0 mg nicotine (http://europa.eu.int/eur-lex/en/com/pdf/1999/en-599PC0594.pdf accessed on April 11). The promotion of official low-tar cigarettes helps keep health-conscious smokers smoking[2,3] and is arguably the cigarette industry's main response to the disease risks of smoking.[4] Whether such low-tar cigarettes offer any reduction in risk of death and disability is doubtful.[5,6] The smoking-machine procedure (a 35 mL puff of 2 s duration every 60 s) originated in 1936 for manufacturer testing of tobacco blends.[7] At that time, cigarettes were generally 70 mm and unfiltered and all brands were similar to each other. Today, cigarettes vary greatly in length (70–120 mm), width, tobacco blends, and degree of filter ventilation (0% to more than 80% air dilution).[8]

Public-health authorities around the world have been considering a change in the way cigarettes are tested for tar and nicotine[9,10] (http://europa.eu.int/eur-lex/en/com/pdf/1999/en-599PCO594.pdf, www.cancer.org/tobacco/nicotine_report/appendixc.html and www.cctc.ca/bcreports accessed on April 11). The Commonwealth of Massachusetts in the USA has tested cigarettes to reflect a more intensive smoking regimen (a 45 mL puff of 2 s duration every 30 s, with 50% of filter vents blocked) than used by the Federal Trade Commission (FTC; www.cancer.org/tobacco/nicotine_report/appendixc.html accessed on April 11). In British Colombia, Canada, the authorities have added more intensive puffing settings as well as tests for selective toxins in smoke.[7] Independent experts have recommended that cigarettes also be tested for nicotine content of tobacco.[11] The industry recognises that the use of more intensive smoking settings has little effect on the ranking of cigarettes.[12]

We believe that simply smoking all cigarettes more intensely does not provide a preferred system for consumers or regulators. We propose a two-stage variable machine-setting procedure that would lead to a new set of scores for cigarettes. Our system addresses the reality that smokers engage increasingly in compensatory smoking—as standard tar and nicotine yields decrease, more frequent and larger puffs are taken and filter vents are blocked.

Public complaining and private capitalising

Although publicly resisting the official smoking-machine tests, manufacturers have designed cigarettes to capitalise on the testing system (www.tobaccopapers.org/documents/psc60c.pdf [Bates Number 100501696], accessed on April 11). Industry documents describe an awareness of cheating the official system by designing "elastic" cigarettes that give low numbers to the machine and high numbers to smokers (www.tobaccopapers.org/documents/psc60c.pdf [Bates Number 100501696], www.tobaccopapers.org/documents/psc76a.pdf [Bates Number 102393928], and www.lorillarddocs.com [Bates Number 01322400], accessed on April 11). One British-American Tobacco Company document measured elasticity by comparison of yields from 50 mL puffs with those from standard 35 mL puffs; the more yields increase beyond the volumetrically expected ratio, the more elastic the cigarette (www.tobaccopapers.org/documents/psc76a.pdf [Bates Number 102393928], accessed on April 11). Industry documents disclose that smokers smoke lower-yield cigarettes more intensely than higher-yield cigarettes (www.lorillarddocs.com [Bates Number 01322400], accessed on April 11). This finding is supported by independent research.[13,14] The industry has tested lower-yield cigarettes at 50 mL or 60 mL puffs once every 20–30 s (compared with a standard of 35 mL puffs every 60 s) to reflect values closer to what smokers are actually likely to achieve (www.lorillarddocs.com [Bates Number 01322400], and www.rjrtdocs.com [Bates Number 510934863], accessed on April 11). One experimental blend of an extremely low-yield cigarette (0·1 mg nicotine FTC) gave seven times the nicotine yield when smoked with 50 mL puffs every 30 s (50/30 condition; (www.rjrtdocs.com [Bates Number 512480043], accessed on April 11).

A two-stage compensating test

We propose a two-stage variable machine-setting procedure. Stage one uses the current standard regimen, and we suggest setting maximum tar to 10 mg and maximum nicotine to 1·0 mg, as proposed for the EU. The second stage would be determined by nicotine yields ranging from a maximum of 1·0 mg to a minimum of 0·1 mg nicotine. The stage-two machine settings are a function of the stage-one results. For a cigarette with 1·0 mg nicotine, a 40 mL puff is taken every 60 s. With every decrease of 0·1 mg nicotine, puff volume rises by 4 mL and puff frequency falls by 4 s. Therefore, a 0·5 mg nicotine cigarette would be smoked at 60 mL puffs every

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40 s, and a 0·1 mg nicotine cigarette would be smoked at 76 mL puffs every 24 s. All puffs would be of 2 s duration. Although the exact settings can be debated, the system should not judge a cigarette as lower yield unless it is lower yield despite more intensive smoking. Even though the most intense setting might seem strikingly high, consider that the industry has included 90 mL as a puff volume "expected for normal smoking behaviour" (www.pmdocs.com [Bates Number 2028629469], accessed on April 11) and an 80 mL puff every 10 s to model human smoking behaviour on 1·0 mg tar cigarettes (www.rjrtdocs.com [Bates Number 510934863], accessed on April 11).

The value of this two-stage test can be assessed by experiments in human smokers;[15] the average intake of nicotine (as indexed by nicotine or cotinine concentrations in the body) should correlate highly with the second-stage nicotine results. Although such tests in human beings are feasible, they are expensive and since many brands of cigarettes are sold, are unlikely to happen. For about 30 years the current system has persisted and has been shown to overestimate actual yield reductions.[16,17] Even without testing on human beings first, the proposed revision should be an improvement.

Tar/nicotine ratios

Russell[18,19] and others[10] have encouraged the use of tar/nicotine ratios to classify cigarettes; less tar per unit of nicotine is better. However, that tar/nicotine ratios will change as a function of machine-smoking conditions is not widely appreciated. In a study of machine-testing of several Canadian brands of cigarettes under standard conditions, the tar/nicotine ratio for ultralight brands was 9·97, increasing under intense conditions to 11·89 (a 19·3% increase). This intense score for ultralights was numerically higher than the standard score of 11·61 for light cigarettes, which increased to 12·55 under more intense smoking.[20] One industry study (www.rjrtdocs.com [Bates Number 510934863], accessed on April 11) showed that one blend of FTC 1·0 mg tar cigarettes had a tar/nicotine ratio that increased from 8·33 at standard conditions to 10·98 at 50/30 conditions (a 31·8% rise), whereas an experimental blend changed only from 6·36 at standard conditions to 6·72 at 50/30 conditions (a 5·7% increase). Our two-stage system would estimate more meaningful tar/nicotine ratios.

Advantages and disadvantages of proposed two-stage system

Advantages

- Stage one maintains historical continuity for research (not for marketing)
- Stage two would improve modelling of compensatory smoking, ie, actual smoking behaviour.
- Elastic/compensatible cigarettes would be identified as higher in tar and nicotine
- Available equipment and analytical procedures could still be used
- The finding that some lower-yield cigarettes are actually higher yield might promote quitting by health-concerned smokers
- Ratios of tar or specific toxins to nicotine would be based on more realistic values

Disadvantages

- System does not allow for individual differences in smoking behaviour
- There would be some increases in testing expense
- The need to regulate or ban the use of influential descriptors such as light or mild would remain
- System may still underestimate compensation

Reduction of standard yields by filter ventilation

Increase of filter ventilation is likely to be the main way that the cigarette industry will comply with the EU's proposed new ceiling for tar and nicotine. Degree of ventilation was probably the key to Philip Morris' compliance with earlier EU requirements (www.pmdocs.com [Bates Number 2024270885], accessed on April 11). Our testing of cigarettes shows that Marlboro (19·5) and Marlboro Light (44·9) are twice as vented in the UK as in the USA (10·2 and 22·5),[8] allowing these cigarettes to meet the European maximum tar-yield limit. Industry documents indicate that vent blocking with lips is more likely with highly vented cigarettes (www.pmdocs.com [Bates Number 2501268539], and www.tobaccopapers.org/documents/psc71e.pdf [Bates Number 109874617], accessed on April 11). We propose also that 50% blockage should be added to the testing conditions if the brand does not have clearly marked vent locations and written intructions included to not block vents with fingers or lips.[21]

Costs and benefits

We believe a two-stage testing proposal is practical (panel). This technique would be more expensive than the current procedure, but not prohibitively so for such a profitable and taxable product. Currently manufactured equipment could be used for the tests, and the basic chemical analyses are unchanged. Testing costs would be roughly double the presently low cost. In the USA, 1262 varieties of domestic cigarette brands were listed in a FTC report.[22] The increased testing costs, if a burden, might encourage manufactuers to withdraw less successful varieties. Reduction of the number of samples tested per variety would also lower costs. Such a measure would diminish the precision of tests, but current tests may be viewed as overprecise, given the intrinsic variability in human smoking behaviour and the actual uses of the measures.

The benefits of a revised procedure are likely to arise from the public being better informed. If low-tar cigarettes become indistinct from many middle-tar and high-tar cigarettes, the illusion that traditional lower-tar cigarettes are a reasonable alternative to stopping smoking altogether should become less tenable. Massachusetts has been somewhat successful in informing its smoking public through targeted television advertising that low-tar cigarettes are dangerous.[23] Comparison of smoking habits in Massachusetts with those in the rest of the continental USA showed that Massachusetts had a higher proportion of people who had recently stopped smoking; multivariate analyses suggested that anti-low-tar television advertisements contributed to this effect.[23]

Cigarette manufacturers have been using tests of tar and nicotine to their advantage for years, designing cigarettes to cheat the process by taking advantage of compensation by smokers. The sliding scale we propose will help to simulate compensation and better information about cigarettes is likely to increase numbers of smokers giving up cigarettes.

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